George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

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Project Plan

for

Space Transportation Research (STR)

ADVANCED SPACE TRANSPORTATION PROGRAM OFFICE (ASTP)
TD15

CHECK THE MASTER LIST-VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

SPACE TRANSPORTATION RESEARCH PROJECT PLAN

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SPACE TRANSPORTATION RESEARCH PROJECT PLAN

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LIST OF ACRONYMS

ARC	Ames Research Center
ASTP	Advanced Space Transportation Program
BPP	Breakthrough Propulsion Physics
CDR	Critical Design Review
CWC	Collaborative Work Commitments
DOD	Department of Defense
DOE	Department of Energy
EAA	Enterprise Associate Administrator
FRR	Flight Readiness Review
FY	Fiscal Year
GPMC	Governing Program Management Council
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
IA	Independent Assessment
IAR	Independent Annual Review
ISO	Industrial Safety Office
ITAR	International Traffic In Arms Regulations
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LANTR	LOX Augmented Nuclear Thermal Rocket
LaRC	Langley Research Center
LEO	Low Earth Orbit
LOX	Liquid Oxygen
MM.	MSFC Manual
MMI	MSFC Management Instruction
MSFC	Marshall Space Flight Center
NAR	Non Advocate Review
NASA	National Aeronautics and Space Administration
NHB	NASA Handbook
NPD.	NASA Program Directive
NPG	NASA Procedures and Guidelines
NRA	NASA Research Announcement
PAPAC	Provide Aerospace Products and Capabilities
PCA	Program Commitment Agreement
PCC	Program (Project) Cost Commitment
PDR	Preliminary Design Review

PDRE	Pulsed Detonation Rocket Engine
PMC	Project Management Council
POC	Point of Contact
RLV	Reusable Launch Vehicle
S&MA	Safety and Mission Assurance
STD	Space Transportation Directorate
STR	Space Transportation Research
TBD	To Be Determined
WBS	Work Breakdown Structure

FOREWORD

This Project Plan describes the planning and objectives for the implementation of a NASA project known as the Space Transportation Research Project. This plan has been prepared in accordance with the *NASA Program and Project Management Processes and Requirements*, NPG 7120.5A, and is consistent with the *NASA Strategic Management Handbook* and *NASA Program/Project Management*, NPD 7120.4. In addition, it follows the MSFC Lead Center Implementation Plan for Space Transportation System Development and Technology Programs.

I. INTRODUCTION

Space Transportation Research (STR) is a project under the Advanced Space Transportation Program Office (ASTP), which is a part of the Space Transportation Directorate (STD) at Marshall Space Flight Center (MSFC).

The MSFC was named as a Center of Excellence for Propulsion and the Lead Center for Space Transportation. When the ASTP Office was being formulated, the STR project office was created to support, within MSFC as a Center of Excellence requirement, an emphasis on identifying and pursuing promising new propulsion concepts that could enable new space missions and substantially reduce costs. As a Lead Center requirement, an objective was to utilize and enhance in-house propulsion research capabilities at appropriate NASA Centers, and to utilize existing research facilities at Department of Defense (DOD) and Department of Energy (DOE) laboratories, universities, and industry. As funding levels permit, NASA Research Announcements (NRA) are to be released to provide emphasis and focus on certain research areas.

II. OBJECTIVES

The goal of the STR Project is to pursue research to enable dramatic high-payoff improvements in space transportation.

The primary objectives of STR are to develop meaningful research plans, perform appropriate analyses, set up and conduct appropriate and meaningful experiments, manage contracts with universities and industry, cooperate with other national laboratories, and prepare and present technical papers for professional conferences to support research.

Research will be supported that may contribute to:

- Significantly reducing the cost of access to space
- Significantly reducing the cost or trip time of in-space transportation
- Enabling new mission opportunities

Emphasis will be placed on propulsion-related research. Activities should involve experimentation in conjunction with analyses and some experimental results should generally be available within each year of activity.

The STR Project will generally not support research related to operations, human factors, environmental impacts, sociology, finance, insurance, and evolutionary improvements to existing systems.

III. CUSTOMER DEFINITION AND ADVOCACY

The primary customer for the Space Transportation Research Project is NASA's Advanced Space Transportation Program (ASTP). ASTP is interested in the development and test of technologies that will potentially provide low-cost space transfer and have low development costs. The Space Transportation Research customer base also include:

- Universities/Academia
- Office of Earth Science (OES)
- Office of Space Science (OSS)
- Office of Life & Microgravity Sciences & Applications (OLMSA)
- Office of Aero-Space Technology (OAT)
- Department of Defense (DoD)
- Department of Energy (DOE)
- Industry

IV. PROJECT AUTHORITY

The *NASA Strategic Plan* and the *NASA Strategic Management Handbook* assign to MSFC the Lead Center responsibility for Space Transportation Systems development. This assignment includes Lead Center responsibility for the Advanced Space Transportation Program of which the Space Transportation Research Project is a part. The Space Transportation Research Project Office is responsible for project implementation and management. The Space Transportation Research Project Office has direct commitments with MSFC and other NASA centers through the prime contractors or between the Project Office and NASA Centers. The MSFC Program Management Council (PMC) is responsible for oversight of the Space Transportation Research Project.

V. MANAGEMENT

A. Organization and Responsibilities

1. NASA Headquarters

The Office of Aero-Space Technology (Code R) is the NASA Headquarters office responsible for the Space Transportation Research Project.

2. Field Centers

The field centers involved in the Space Transportation Research Project include: Marshall Space Flight Center, Glenn Research Center (GRC), Jet Propulsion Laboratory (JPL), Ames

Research Center (ARC), Langley Research Center (LaRC) and Johnson Space Center (JSC). The involvement of each center is described below:

a. Marshall Space Flight Center

Responsibility for the Space Transportation Research Project falls under the ASTP. The Space Transportation Research Project Manager has a small team consisting of members of involved Directorates within MSFC, and representatives from other involved centers. This team is responsible for planning, coordinating and interfacing with other projects and organizations as appropriate to accomplish the job.

Program Management (Level II)

Overall Program Management is provided by the Advanced Space Transportation Program Office.

Project Management (Level III)

The Project Manager is assigned by MSFC's ASTP office and reports to the ASTP Program Manager (Level II). The Project Manager is responsible for developing an approach to meet the objectives established by the ASTP Program Manager; developing lower level project constraints such as budget, resources and schedule; and implementation planning that coordinates NASA and contractor assets.

The products of the Project Manager are:

- **Project Plan**. The Project Plan shall be written in accordance with NPG 7120.5A.
- **Integrated Project Schedule**. The Integrated Project Schedule shall be developed using Microsoft Project and will contain all tasks identified by the appropriate teams and the Project Management. The tasks shall be logically linked with the critical path identified. The project schedule shall contain detailed schedules of all project elements and shall be updated in a timely manner. The project schedule shall contain the baseline schedule and deviations from the baseline. The Project Manager must approve changes to the baseline schedule.
- **Resource Allocations** (POP inputs). The Resource Allocations contain estimates of budget requirements and manpower requirements. This report indicates when budgeted funds will be obligated and costed, as well as the cost of in-house manpower and its phasing. The Project Manager is assisted by a Business Manager who is assigned by the ASTP management. The Business Manager's primary responsibility is to assure that all procurements are planned and purchased in time to support the project schedule. The Business Manager shall work with the task

managers to evaluate procurement needs and schedule; track expenditures; and reports progress and issues to the project manager.

- **Collaborative Work Commitments** (CWC). The Project Manager will develop CWCs per MSFC-P03.1-C01. The Project Manager will be assisted by the Lead Systems Engineer. CWCs are controlled by the Project Manager and held as a quality record in accordance with MSFC-P16.1 for 6 months after completion of the task.

Engineering Management (Level IV)

The Lead Systems Engineer is assigned by Space Transportation Directorate and reports to the Project Manager. The Lead Systems Engineer is responsible to the project for ensuring that all engineering aspects of funded tasks, including in-house, other centers and contractor responsibilities are accomplished within the technical requirements and cost and schedule restraints.

The products of the Lead Systems Engineer are:

- CWCs that support project schedule.
- Level IV directives releasing drawings, documentation and change control documentation.
- COTR support and documentation for contracts that support the project tasks.
- Design review agendas, review team coordination, and pre-board disposition.

MSFC Task Managers will be assigned for each task funded within the project. Their role will be technical with regard to the nature of the work being conducted in the task.

b. Other Centers

Other NASA Centers participating in STR will each assign a Point of Contact (POC) to work with the Project Manager to define meaningful tasks to be managed by that center. Task descriptions, milestones, names of individuals responsible for managing the task, descriptions of deliverables, funding requirements consistent with allocations to the center, and anticipated support to reviews and conferences will be included in a task sheet compiled by the POC and approved by the Project Manager. The POC will be responsible for assuring the implementation of the approved tasks and will provide quarterly progress information for presentation to appropriate review boards described below.

- **Assignments**

GRC

- Advanced Fuels

- Some Advanced Nuclear Thermal Propulsion concepts
- Magnetic Nozzle design capability development and demo
- Magnetic Nozzle experiments using fusion like plasmas
- Breakthrough Propulsion Physics (BPP)

JPL

- New Concepts
- Fusion Studies
- High power plasma thrusters
- Advanced mission and system studies
- Plasma simulation and modeling
- 11th Advanced Propulsion Workshop

JSC

- Plasma Rocket research

ARC

- Evaluation of AJAX type scramjet
- Evaluation of microwave lightcraft MHD accelerator concept
- Advanced fuel analysis

LaRC

- Launch vehicle systems analyses as required
- Materials support for beamed energy vehicles

MSFC

- Advanced Chemical concepts
- Electromagnetic propulsion concepts
- Nuclear propulsion concepts
- Fusion and Antimatter propulsion concepts
- Programmatic support

B. Special Boards and Committees

The Project Manager shall schedule independent reviews with technical experts not associated with the development activity. These reviews will coincide with the design reviews.

C. Management Support Systems

The following management systems will be utilized with the Space Transportation Research Project. In addition, other systems within the agency are being reviewed and considered as potentials.

1. Marshall Resources Tracking System (MARTS)

The MARTS system for tracking funding authority, commitments, obligations, cost and disbursements will be utilized by Space Transportation Research Project.

2. Workforce Information System (WIS)

The WIS system will be utilized for tracking the civil service workforce associated with Space Transportation Research Project.

3. Automated Procurement Request System (APRS)

The S&E APRS system will be used for the Procurement Requests (Form 424) process.

4. Virtual Research Center (VRC)

The VRC is an Internet-based project management and document management system that allows all project team members access to project documents, drawings, meeting notes, assigned action items and the group calendar.

5. Other Management Systems

Current plans call for the implementation by June 1, 2000 of the Integrated Financial Management Planning (IFMP) system. This is a mandatory, agency wide tool for budgeting, tracking and analyzing funding.

VI. TECHNICAL SUMMARY

The emphasis of this research will concentrate on propulsion since the most significant reductions in the cost of access to space and in-space transportation is in this area. The two avenues currently being pursued are the use of off-board resources and the use of advanced cycles and fuels. Low cost experiments will be encouraged leveraging the expertise and facilities of NASA centers, other governmental agencies, universities, and industry. The general areas of research will include advanced chemical propulsion, electromagnetic propulsion, advanced nuclear propulsion, fusion and antimatter propulsion, and perhaps combinations. Some research into Breakthrough Propulsion Physics, emerging new physics which may relate to propulsion, will also be pursued.

This research will be driven by potential new technology capabilities rather than by specific mission requirements. System analyses of candidate missions and vehicle concepts will be encouraged

to understand the requirements that may arise from these applications. As funds are available focus areas will be identified for a technology development push. A research objective is to keep as many options open as possible and to avoid concept down-selections, consistent with availability of funds. This may help provide appropriate competition in a later development phase.

Initial emphasis will be given to improving NASA-wide in-house research competence and capability, as well as utilizing the facilities and expertise within the DoD and DoE National Labs, colleges and universities, and within industry. Research will be selected by the Project Manager based on evaluated solicitations and recommendations from the various NASA assigned POC's and task managers. Results of research efforts will be documented via publication in professional journals and conference papers, consistent with International Traffic In Arms Regulations (ITAR) restrictions, and by quarterly and final reports.

NASA will undertake low-cost activities to learn how to generate, control, and manipulate fusion-like plasmas for concepts that may have applications to space propulsion. However, NASA will not undertake activities to perform basic research in nuclear fission or fusion that contributes to weapons development capabilities.

VII. SCHEDULES

A. Advanced Chemical Propulsion

- 3QFY00 - Advanced strained ring hydrocarbons fuel test.

  Output: Demonstrate in a small rocket engine the performance improvements of several promising strained ring hydrocarbons. To measure thrust chamber pressure and specific impulse of these first series high performance hydrocarbon fuel.

  Outcome: Significantly improve hydrocarbon fuel performance, which can reduce the cost to access to space.

- 1QFY01 - Pulsed Detonation Rocket Engine (PDRE) performance code demonstration.

  Output: Demonstrate on benchmark type data an initial time dependent energy balance computer code for estimating the performance of pulse detonation rocket engines.

  Outcome: PDRE may reduce the cost to access to space.

B. Electromagnetic Propulsion

- 2QFY00 - Hypersonic AJAX type concept evaluation.

  Output: To develop a task plan and to initiate an activity with Ames Research Center (ARC) to perform system analysis to evaluate an AJAX type concept.

  Outcome: Efficient AJAX type concepts may contribute to reducing cost to access to space.

C. Nuclear Propulsion

- 3QFY00 - Simulated bimodal heat pipe reactor initial test.

  Output: Complete first series of tests of a simulated bimodal heat pipe reactor in both nuclear electric and nuclear thermal propulsion modes.

  Outcome: To enable new missions that will reduce trip time for interplanetary propulsion.

- 1QFY01 - LOX Augmented Nuclear Thermal Rocket (LANTR) hot fire test preparations completed.

  Output: Preparations completed for LANTR hot fire test series.

  Outcome: To enable new missions and will reduce trip time for interplanetary propulsion

D. Fusion Propulsion

- 3QFY00 - Fusion Propulsion planning team

  Output: Initiate a national level, cross agency and academia planning team for recommending a proper course of action to pursue fusion propulsion.

  Outcome: Human exploration beyond Mars will require propulsion systems with fusion like performance to reduce trip time to acceptable durations.

E. Programmatic

- 4QFY00 - NASA Advanced Propulsion Workshop

  Output: Convene an advanced propulsion workshop in Pasadena, CA

  Outcome: Identifying and researching advanced propulsion concepts are essential to enabling practical and low cost future exploration and development of space.

VIII. RESOURCES

The project funding plan by fiscal year is shown below:

A. Funding Requirements (NOA in Millions)

FY00	FY01	FY02	FY03	FY04	TOTALS
5.9	4.8	5.8	5.8	5.8	28.1

B. Institutional Requirements (FTE)

FY00	FY01	FY02	FY03	TOTALS
50	50	50	50	100

IX. CONTROLS

The Space Transportation Research Project is subject to the controls as contained in NASA Procedures and Guidelines, NPG 7120.5A, effective April 3, 1998. The Space Transportation Research Project Plan establishes the top level technical, schedule, and cost controls placed on the program. A semi-annual review of this plan will be performed to accommodate the changing nature of advanced technology projects. Responsibilities for Program and Project Management are as follows:

A. Headquarters Responsibilities

Associate Administrator for Aero-Space Technology

a. Providing program advocacy.
b. Establishing program requirements and metrics.
c. Recommending the level of GPMC oversight for each new program.
d. Assigning program and selected project responsibilities to Lead Centers.
e. Recommending new programs to the Agency PMC.
f. Developing, coordinating, and maintaining the PCA.
g. Approving Program Plans.
h. Assessing program performance against requirements and customer expectations.
i. Ensuring timely resolution of multiple program and project issues with assigned enterprise.
j. Serving as a member of the GPMC.
k. Allocating budgets to programs.

B. Center Responsibilities

1. Lead Center Director (MSFC)

a. Serving as Chairperson of Lead Center PMC.
b. Supporting the Associate Administrator of Aeronautics and Space Transportation Technology in program formulation.
c. Providing overall direction, control, and oversight of program implementation.
d. Appointing the program manager.
e. Concurring on the Program Plan for Associate Administrator approval.
f. Assigning work to other Centers.
g. Integrating institutional resources with program needs.
h. Coordinating cross-Center activities.
i. Ensuring compliance to policy/standards.
j. Maintaining dual path for Quality and IA.
k. Developing and maintaining program/project implementation policies and procedures compliant with NPD 7120.4, NPG 7120.5A, and ISO 9000.

2. Performing Center Director (MSFC)

a. Performing advanced concept studies in support of Agency and enterprise strategic plans.
b. Supporting the program formulation.
c. Approving Project Plan.
d. Appointing the Project Manager.
e. Project implementation and oversight.
f. Developing and maintaining program/project implementation policies and procedures compliant with NPD 7120.4, NPG 7120.5A, and ISO 9000.

3. ASTP Program Manager

a. Program planning, including: recommendation of program objectives, requirements, implementation guidelines, program integration, budget and milestones, and preparation of Program Plans and PCA's.
b. Developing, recommending, and advocating the program resources.
c. Execution of the Program Plan and oversight.
d. Approving Project Plans and associated changes to these documents.
e. Reviewing and reporting program/project performance.
f. Establishment of project requirements and performance metrics.
g. Allocating budget to projects.
h. Control of program changes.
i. Establishing support agreements.

4. Space Transportation Research Project Manager

a. Preparation and maintenance of the Project Plan, specifications, schedules, and budgets.
b. Acquisition and utilization of participating contractors.
c. Execution of the Project Plan.
d. Reporting project status.
e. Approving Task Agreements and CWCs.
f. Conducting design and all other appropriate reviews.
g. Participation in Configuration Control Board Activity.

5. STR Points of Contact (POC)

a. Preparation and maintenance of task sheets for center assignments.
b. Execution of the tasks
c. Reporting task status
d. Internal reviews as appropriate.
e. Provide guidance and recommendations to the Project Manager regarding agency wide research task selections, assignments, procedures improvements, and policies.

X. IMPLEMENTATION APPROACH

A. Implementation Plan

The Space Transportation Research Project is a research project intent on developing a technologies that reduce risk and cost associated with space launch vehicles.

B. Project Summary Work Breakdown Structure (WBS)

1 **Advanced Chemical Propulsion**
1.1 Revolutionary Rockets
1.1.1 Pulse Detonation Combined Cycle Engine (PDCCE)
1.1.1.1 Code Development
1.1.1.2 In-House Test
1.1.2 Pulse Detonation Rocket Engine (PDRE)
1.1.3 Liquid Air Combustion Engines
1.1.4 Deeply Cooled Air Rocket Engines
1.2 Advanced Fuels and High Energy Density Materials
1.2.1 Strained Ring Hydrocarbons
1.2.2 Recombination Energy Fuel
1.2.3 Azide Fuel

1.2.4 Penta Nitrogen
1.2.5 Metalized and Gelled Fuels
1.3 Launch Assist
1.3.1 Cannons
1.3.2 Balloons
1.3.3 Aerial Refueling

2 **Electromagnetic Propulsion**
2.1 Catapults, Coil Guns, and Rail Guns
2.2 MHD/Weekly Ionized Gases
2.3 Micro Propulsion
2.4 Multi Megawatt Electric Propulsion (MMEP)
2.4.1 PIT
2.4.2 PPIT
2.4.3 VASIMR
2.4.4 MPD
2.4.5 Helicon
2.4.6 Inverse Hall
2.5 Advanced Flight Weight Magnets
2.5.1 Superconductor magnet testing
2.5.2 Ultra-pure Aluminum
2.5.3 Low Cost SC Design and Manufacturing
2.5.4 Facility Magnet Set Up and Tests
2.6 Beamed Energy
2.6.1 Laser Lightcraft
2.6.2 Microwave Lightcraft
2.6.3 Laser Debris Removal

3 **Fission Propulsion**
3.1 Heat Pipe Bimoodal
3.2 High Temperature Fuels
3.3 Down Hole Testing
3.4 Pulsed Nuclear
3.5 Orion Concept Analysis
3.6 Hot Spin Isomer Analysis
3.7 Atomic Base Combined Cycle
3.8 LANTR

4 **Fusion Propulsion**
4.1 CMTX

4.2 Magnetized Target Fusion
4.3 Inertia Electrostatic Confinement (IEC)
4.4 Z-Pinch
4.5 Dense Plasma Focus
4.6 Gas Dynamic Mirror
4.7 Antimatter Trap
4.8 SHIVA STAR
4.9 Magnetic Nozzles
4.1 Coaxial Helicity Injection
4.11 Plasma Gun
4.13 E-Beam Heater

5 **Systems Analysis/Concepts Development**

6 **Research Project Management/Systems**
6.1 Facility Operations
6.2 Research Integration

XI. ACQUISITION SUMMARY

The Space Transportation Research Project acquisition strategy is based on both NASA in-house and contracted activities. All of the planned individual contracts are currently anticipated to be less than $10M. Because of the experimental nature of the Space Transportation Research Project and tight time schedules, every emphasis will be placed on short procurement approaches. Existing contracts, NASA Research Announcements, Purchase Orders, and Support Agreements will be utilized to the greatest extent possible.

XII. PROGRAM/PROJECT DEPENDENCIES

Currently the STR has no significant dependencies on other projects.

XIII. AGREEMENTS

A. Internal NASA Agreements

MSFC has been assigned as the Lead Center for the Space Transportation Research Project and is responsible for project implementation and management. The Space Transportation Research Project will require significant coordination between MSFC and the other participating centers.

Coordination on specific technology development activities will be dictated by circumstances on an "as-needed" basis.

B. External Agreements

The Space Transportation Research Project is expected to have external agreements with other agencies.

C. NASA/DoD Agreements

NASA has been assigned the Lead Agency for the development of Reusable Space Transportation systems, most of which have applicability for future DoD technology requirements. NASA and the Air Force have signed a Memorandum of Agreement calling for cooperative technology development and demonstration in support of NASA's Advanced Space Transportation Program and the military Space Operations Vehicle.

XIV. PERFORMANCE ASSURANCE

Quality

Space Transportation Research Project flight hardware designed, developed and built in-house at MSFC will be in accordance with the MPG 144.1. In-house hardware may be built to dated drawings with the approval of the Lead Systems Engineer, as specified in the Space Transportation Research Project Configuration Control Plan. As built drawings will be submitted to the MSFC Configuration Control Process as specified in the Space Transportation Research Project Configuration Control Plan. Space Transportation Research Project flight hardware designed, developed, and built in-house at other Centers will be in accordance with the relevant Center policies and procedures.

Due to the limited scope of the Space Transportation Research Project flight demonstration experiments, flight hardware may be commercial off-the-shelf as long as it meets the requirements specified in the governing specification documents.

Space Transportation Research Project flight hardware purchased from outside vendors is not required to be ISO 9000 compliant. Space Transportation Research Project flight hardware purchased from outside vendors will be based on the specific requirements of NHB 5300.4(1C). Tailoring of these requirements will be reflected in the Space Transportation Research Project Quality Plan and/or in the vendor purchase order/contract.

Space Transportation Research Project flight hardware purchased from outside vendors must be delivered with a Certificate of Compliance (COC) and an acceptance data package as specified in the purchase order or contract.

XV. RISK MANAGEMENT

For all STR activities directly involved with space flight hardware, an aggressive Risk Management Plan will be required. This plan will document a continuous process that:

- identifies risks
- analyzes their impact and prioritizes them
- develops and carries out plans for risk mitigation, acceptance, or other action
- tracks risks and the implementation of mitigation plans
- supports informed, timely, and effective decisions to control risks and mitigation plans
- assures that risk information is communicated among all levels of the project

Risk management begins in the formulation phase with an initial risk identification and development of a Risk Management Plan and continues throughout the product's life cycle through the disposition and tracking of existing and new risks.

XVI. ENVIRONMENTAL IMPACT

Environmental impact assessment(s) shall be developed as needed by the appropriate center(s) Environmental Engineering and Management Office(s).

XVII. SAFETY

The Space Transportation Research Project will utilize existing Center safety guidelines to provide for the early identification, analysis, reduction, and/or elimination of hazards that might cause the following:

- Loss of life or injury/illness to personnel
- Damage to or loss of equipment or property (including software)
- Unexpected or collateral damage as a result of tests
- Failure of mission
- Loss of system availability
- Damage to the environment

As required for specific tasks in the Space Transportation Research Project, a safety plan that details such activities as system safety, reliability engineering, electronic and mechanical parts reliability, quality assurance for both hardware and software, surveillance of the development processes, "closed loop" problem failure reporting and resolution, environmental design and test requirements will be

developed.. Mission success criteria shall be defined to aid in early assessment of the impact of risk management trade-off decisions. The safety and mission success activity shall accomplish the following:

- Provide for formal assessment and documentation of each hazard, with risks identified, analyzed, planned, tracked, and controlled.
- Provide for a safety assessment and certification regarding readiness for flight or operations, explicitly noting any exceptions arising from safety issues and concerns.
- Utilize a quality management system governed by the ISO 9000 standard, appropriate surveillance, and NASA Engineering and Quality Audit (NEQA) techniques.

XVIII. TECHNOLOGY ASSESSMENT

Ongoing assessment of needs for technology will be conducted by project management to insure that long term goals can be met.

XIX. COMMERCIALIZATION

An objective of the Space Transportation Research Project is to ensure rapid and effective dissemination of the technology to the U.S. industry. Technology transfer mechanisms depend on the maturity of the technology. A variety of technology transfer mechanisms will be employed. The most important mechanisms are direct involvement by the customers in the formulation of the project described in this plan, direct contract of R&D and cooperative agreements with industry and other government agencies. The Space Transportation Research Project funds R&D contracts, memoranda of agreement (MOAs) and grants that ensure direct transfer of technology to the U.S. industry, increasing the likelihood of transfer into customer products. Technology exchange also occurs among the participants through special technical working group meetings. Presentations at technical conferences sponsored by the AIAA and other similar professional societies will be limited to discussion of non-competitively sensitive information. Other methods of technology transfer include publication of NASA technical reports, personnel exchanges between NASA, industry and other government agencies through MOAs, and technical demonstrations at NASA and user facilities.

The Space Transportation Research Project will work closely with the Technology Commercialization Office at the respective centers to further communicate technology commercialization opportunities to a wide range of potential users outside the traditional aerospace community. This includes such fields such as medical, ground transportation, and communications. It also includes educational opportunities including kindergarten to grade 12.

To be successful in this commercialization effort, NASA must concentrate on maturing and transferring technologies that will retire the risk of developing commercial launch systems. Commercial

potential will be, therefore, a major driver in ASTP project prioritization. Both existing and entrepreneurial commercial opportunities will be supported, with the basis for support being analysis of the likelihood and extent that the technology will contribute to meeting stated project objectives – primarily transportation cost reductions. The ASTP is also providing many opportunities for small disadvantaged and non-conventional aerospace companies to work cooperatively with NASA to develop another sector of their business.

XX. REVIEWS

A. Management Reviews

Management Reviews will be scheduled during the life of the project. The type and frequency of the reviews will be established according to the unique needs of the Project and the Program Office . The reviews will be scheduled to keep program and project management informed of the current status of existing or potential problem areas. Agency management will be informed, in advance, of the schedule and agenda of the major reviews and will be invited to participate at their discretion. Special reviews by any level of management will be conducted when the need arises.

1. Lead Center Program Management Council (PMC) Review

The Marshall Space Flight Center lead center PMC will review the Space Transportation Research Project annually. The reviews will cover overall status information, including schedule, change, performance, funding, interfaces coordination, and other management and technical topics. The Lead Center PMC review will also assess project progress against metrics and criteria proposed in procurement instruments.

2. Quarterly Program Review

A quarterly program review will be held to review cost, schedule, and technical issues. The location of the review will be determined on a case-by-case basis. Participants will include, as a minimum, the program managers of the ASTP and STD offices.

3. Other Reviews

Other independent reviews will be scheduled as required and will include the participation of all NASA Centers involved in the Space Transportation Research Project. The reviews will cover the overall status information and will include schedule status, change status, performance status, interface coordination, and other management and technical topics.

B. Technical Reviews

Each technology research effort will be reviewed annually to assess progress. Decisions for continuation, redirection, and/or cancellation will be made at that time.

XXI. TAILORING

The requirements of NASA Policy Directive (NPD) 7120.4A and NASA Procedures and Guidelines (NPG) 7120.5A apply to this program as tailored by the ASTP Program Plan.

XXII. RECORDS RETENTION

The Space Transportation Research Project Manager will determine which project records will be retained and for how long in order to ensure a permanent record of the project and lessons learned are available to benefit future NASA projects. Governing documents will be kept in accordance with the required policies and procedures of the relevant Center.

XXIII. CHANGE LOG

EFF. DATE	STATUS	DOC. REVISION	DESCRIPTION
Dec 13, 1999	Baseline	-	Initial Issue.